



Docket No.: M4065.0698/P698  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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In re Patent Application of:  
Kristy A. Campbell et al.

Confirmation No.: 8483

Application No.: 09/943,190

Art Unit: 2825

Filed: August 29, 2001

Examiner: R. Rocchegiani

For: METHOD OF FORMING CHALCOGENIDE  
COMPRISING DEVICES, METHOD OF  
FORMING A PROGRAMMABLE MEMORY  
CELL OF MEMORY CIRCUITRY, AND A  
CHALCOGENIDE COMPRISING DEVICE  
(AS AMENDED)

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**DECLARATION OF JOHN T. MOORE UNDER 37 C.F.R. § 1.131**

Dear Sir:

I, John T. Moore, do hereby declare and state as follows:

1. I reside at 12530 W. Lexus Court, Boise, ID.
2. I am one of the joint inventors of the above-identified U.S. patent application (the "'190 application"), filed on August 29, 2001, as evidenced by the attached the executed Declaration document filed with the United States Patent and Trademark Office on August 29, 2001 (Exhibit A).
3. Micron Technology, Inc. is the assignee of the present application, as shown by the attached Assignment (Exhibit B).
4. I have reviewed and understand the '190 application, including the currently pending claims, including any and all amendments (the "Claimed Invention").

**BEST AVAILABLE COPY**

5. I, together with Kristy A. Campbell, jointly conceived of the invention covered by the Claimed Invention prior to February 8, 2001, as evidenced by Exhibit C (attached hereto), which is a Micron Technology, Inc. Patent Committee Proposal Document (the "Invention Disclosure"). The actual date of this submission has been blanked out, as has any description not relevant to the conception of the Claimed Invention; however, the noted date of conception on the Invention Disclosure predates February 8, 2001. Further, the Invention Disclosure also has a date that Micron Technology, Inc. began actual use of the invention experimentally. This date, too, is blanked out, but is before February 8, 2001. Thus, embodiments of the Claimed Invention were actually made prior to February 8, 2001.

6. Attached as Exhibits D and E are scanning electron microscopy (SEM) photographs of devices, evidencing an actual reduction to practice of the Claimed Invention. The devices pictured in Exhibits D and E were the result of the aforementioned reduction of the invention by Micron Technology, Inc. Thus, the devices in accordance with the Claimed Invention were fabricated prior to February 8, 2001.

7. Exhibits D and E illustrate devices with the following structure:

- 1) a substrate;
- 2) a first conductive electrode material on the substrate;
- 3) a nitride layer;
- 4) an amorphous chalcogenide comprising material, specifically, a  $\text{Ge}_x\text{Se}_y$  comprising material having silver diffused therein, of a first thickness over the first conductive electrode material;
- 5) a silver layer over the chalcogenide comprising material; and

6) a second conductive electrode over the chalcogenide comprising material.

8. The silver layer was formed to a second thickness that was less than, but not within 10% of a transition thickness of the silver layer. The transition thickness is a thickness of the silver layer which, when diffused into the chalcogenide comprising material, transforms said chalcogenide comprising material from an amorphous to a crystalline state. The silver layer was irradiated such that some of the silver was diffused into the chalcogenide material. Otherwise stated, the silver layer was irradiated to break a chalcogenide bond of the chalcogenide comprising material at an interface of the silver layer and chalcogenide comprising material causing silver to diffuse into the chalcogenide comprising material; however, the chalcogenide comprising material remained amorphous. The region of the chalcogenide material that is displaced from the interface of the silver layer and the chalcogenide comprising material has a higher concentration of Ge than the region adjacent the interface. The devices pictured in Exhibits D and E show that the chalcogenide comprising device in accordance with the Claimed Invention was produced prior to February 8, 2001.

9. Attached as Exhibits F and G are charts and a graph relating to an actual reduction to practice of the Claimed Invention prior to February 8, 2001. The data included in Exhibits F and G was acquired as a result of experimentation on the physical embodiments of the Claimed Invention conducted prior to February 8, 2001.

10. Exhibit F includes charts containing electrical data for devices of lot 44610.1. Like the devices shown in Exhibits D and E, the devices of lot 44610.1 were fabricated according to the Claimed Invention. Exhibit G is an I-V curve for the 0.5 um device of Exhibit F. The data in Exhibits F and G show that devices of lot 44610.1 functioned as memory devices prior to February 8, 2001. Therefore, the data of Exhibits

F and G show that the Claimed Inventions existed and worked for their intended purpose prior to February 8, 2001.

11. The attached Exhibits are records, photocopies of original photographs, and other original evidence of my conception and reduction to practice of the Claimed Inventions prior to February 8, 2001.


All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the above-identified patent.

**FURTHER THE DECLARANT SAYETH NOT**

Date: \_\_\_\_\_

9/9/04

By: \_\_\_\_\_

  
John T. Moore



Docket No.: M4065.0698/P698  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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Kristy A. Campbell et al.

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FORMING A PROGRAMMABLE MEMORY  
CELL OF MEMORY CIRCUITRY, AND A  
CHALCOGENIDE COMPRISING DEVICE  
(AS AMENDED)

**DECLARATION OF KRISTY A. CAMPBELL UNDER 37 C.F.R. § 1.131**

Dear Sir:

I, Kristy A. Campbell, do hereby declare and state as follows:

1. I reside at 5131 S. Tinker St., Boise, ID.
2. I am one of the joint inventors of the above-identified U.S. patent application (the " '190 application"), filed on August 29, 2001, as evidenced by the attached the executed Declaration document filed with the United States Patent and Trademark Office on August 29, 2001 (Exhibit A).
3. Micron Technology, Inc. is the assignee of the present application, as shown by the attached Assignment (Exhibit B).
4. I have reviewed and understand the '190 application, including the currently pending claims, including any and all amendments (the "Claimed Invention").

5. I, together with John T. Moore, jointly conceived of the invention covered by the Claimed Invention prior to February 8, 2001, as evidenced by Exhibit C (attached hereto), which is a Micron Technology, Inc. Patent Committee Proposal Document (the "Invention Disclosure"). The actual date of this submission has been blanked out, as has any description not relevant to the conception of the Claimed Invention; however, the noted date of conception on the Invention Disclosure predates February 8, 2001. Further, the Invention Disclosure also has a date that Micron Technology, Inc. began actual use of the invention experimentally. This date, too, is blanked out, but is before February 8, 2001. Thus, embodiments of the Claimed Invention were actually made prior to February 8, 2001.

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F and G show that the Claimed Inventions existed and worked for their intended purpose prior to February 8, 2001.

11. The attached Exhibits are records, photocopies of original photographs, and other original evidence of my conception and reduction to practice of the Claimed Inventions prior to February 8, 2001.

All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the above-identified patent.

**FURTHER THE DECLARANT SAYETH NOT**

Date: 9/9/04

By: Kristy A. Campbell  
Kristy A. Campbell





EL 465782316

**DECLARATION OF JOINT INVENTORS FOR PATENT APPLICATION**

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled "Method of Forming Non-Volatile Resistance Variable Devices, Method of Forming a Programmable Memory Cell of Memory Circuitry, and a Non-Volatile Resistance Variable Device", the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

**PRIOR FOREIGN APPLICATIONS:**

I hereby state that no applications for foreign patents or inventor's certificates have been filed prior to the date of execution of this declaration.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such

willful false statement may jeopardize the validity of the application or any patent issued therefrom.

\* \* \* \* \*

Full name of inventor: **Kristy A. Campbell**

Inventor's Signature:

Kristy A. Campbell

Date:

8/27/01

Residence:

**Boise, Idaho**

Citizenship:

**U.S.A.**

Post Office Address:

**9845 West Mossy Cup Street  
Boise, ID 83709**

\* \* \* \* \*

Full name of inventor:

**John T. Moore**

Inventor's Signature:

John T. Moore

Date:

8/27/01

Residence:

**Boise, Idaho**

Citizenship:

**U.S.A.**

Post Office Address:

**12530 W. Lexus Ct.  
Boise, ID 83713**

## **ASSIGNMENT**

### **PARTIES TO THE ASSIGNMENT:**

#### **INVENTORS:**

Kristy A. Campbell  
John T. Moore

**COPY**

#### **ASSIGNEE:**

Micron Technology, Inc.  
Corporation of the State of Delaware  
8000 South Federal Way  
Boise, Idaho 83716

### **BACKGROUND OF THIS ASSIGNMENT:**

INVENTORS have conceived certain new and useful inventions disclosed in a United States patent application titled "Method of Forming Non-Volatile Resistance Variable Devices, Method of Forming a Programmable Memory Cell of Memory Circuitry, and a Non-Volatile Resistance Variable Device".

MICRON TECHNOLOGY, INC. (hereinafter referred to as "ASSIGNEE") desires to acquire the entire right, title and interest in said inventions and with respect to any Letters Patent that may be granted with respect to the inventions in both the United States and in all foreign countries.

### **THE PARTIES AGREE AS FOLLOWS:**

In consideration of good and valuable consideration, the receipt sufficiency and adequacy of which is hereby acknowledged, INVENTORS hereby sell, assign and transfer to ASSIGNEE the entire right, title and interest in the above-

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identified application executed currently with this assignment and to any reissues, renewals, divisions or continuations thereof, and hereby authorizes the Commissioner of Patents and Trademarks to issue such Letters Patent to ASSIGNEE for the sole use of ASSIGNEE, its successors or assigns.

INVENTORS further agree to execute, at the request and expense of ASSIGNEE such other formal documents as may be required to fully convey the interest transferred herein and will similarly execute any application papers required for the filing of any division, continuation, renewal or reissue of the patent application or resulting Letters Patent; and will generally do everything necessary or desirable to obtain and enforce proper protection for the inventions assigned hereby.

INVENTORS further assign to ASSIGNEE the whole right, title and interest in the inventions disclosed in the application throughout all countries foreign to the United States. ASSIGNEE is hereby authorized to apply for patents relating to the inventions in its own name in countries where such procedure is proper; to claim the benefit of the International Convention; to file and prosecute International Applications relating to the inventions under the Patent Cooperation Treaty; and to file and prosecute applications relating to the inventions under the European Patent Convention. INVENTORS agree to execute applications relating to the inventions in those countries and under those conventions where it is necessary that the same be executed by the inventor, and to execute assignments of such applications and the resulting Letters Patent to ASSIGNEE

**COPY**

as well as all other necessary papers in relation to such applications and Letters Patent.

INVENTORS further warrant and covenant that no assignment, grant, mortgage, license or other agreement affecting the rights and property herein conveyed has been or will be made to others by the undersigned, and that the full rights to convey the same as herein expressed is possessed by the undersigned.

To be binding on the heirs, assigns, representatives and successors of the undersigned and extend to the successors, assigns and nominees of the Assignees.

Dated: 8/27/01

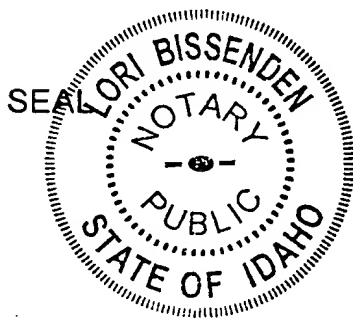
Signature: Kristy A. Campbell  
Kristy A. Campbell

State of Idaho

County of Ada

)  
) ss.  
)

BEFORE ME, this 27<sup>th</sup> day of August, 2001 personally appeared the above-named inventor, known to me to be the person who is described in and who executed the foregoing assignment instrument and acknowledged to me that she executed the same of her own free will for the purpose therein expressed.



Lori Bissenden  
Notary or Consular Officer  
My Commission Expires: 6/12/2004

**COPY**

Dated: 8/27/01

Signature: \_\_\_\_\_

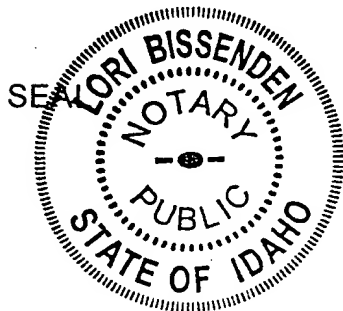
John T. Moore

State of Idaho

County of Ada

)  
) ss.  
)

BEFORE ME, this 27<sup>th</sup> day of August, 2001 personally appeared the above-named inventor, known to me to be the person who is described in and who executed the foregoing assignment instrument and acknowledged to me that he executed the same of his own free will for the purpose therein expressed.



\_\_\_\_\_  
Lori Bissenden  
Notary or Consular Officer

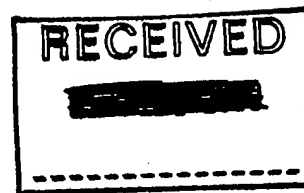
My Commission Expires: 6/12/2004

**COPY**

# INVENTION DISCLOSURE

**1. INVENTOR(S):**

Kristy A Campbell  
John T Moore

**2. DESCRIPTION:****• Title:**

Method to improve PCRAM Ag top electrode coverage

**• Brief Description:**

A method to improve Ag coverage over the PCRAM glass cell is described. Currently, sputtered Ag over either a glass cell or a fully Ag-doped cell leaves void areas with no Ag coverage. We have found that lightly doping the glass cell with approximately 10% Ag prior to sputtering the top Ag electrode over the cell provides complete Ag coverage over the cell.

This procedure has the advantage over existing procedures in that the complete Ag coverage over the glass cell protects the cell from attack by chemicals that are used subsequently in the manufacturing process, such as photodeveloper, wet etch chemicals, and dry etch gases. Furthermore, complete coverage of the glass by the top electrode reduces the device to device inconsistency which could result from variable electrode coverage and selective device chemical attack. Please see SEM results for Lot G5-4244610.1.

**3. CONCEPTION & DOCUMENTATION OF INVENTION:****• Date when first conceived:**

[REDACTED]

**• To whom was the idea first described:**

Terry Gilton

**• On what date:**

[REDACTED]

**• Date of the first tangible record:**

[REDACTED]

**• Type and location:**

PCRAM experiment spreadsheet and lot start.

**4. INFORMATION RELATED TO INVENTION:**

- **Related invention disclosures:**

None.

- **Closest technology:**

None.

- **Advantages of this invention over previous technology:**

This technology allows continuous Ag coverage over the glass cell which thus prevents attack by chemicals used in the manufacture process as well as eliminates device-to-device inconsistency due to the effects of this insufficient silver coverage.

**5. IMPORTANT DATES:**

- **If the invention has been disclosed outside the company, please specify to whom it has been disclosed, when, and in what form:**

Not disclosed.

- **If any articles describing your invention have been published, please specify the author(s), title of article, publication and date:**

None published.

- **If any engineering samples have been given out, please specify to whom and on what date they were given:**

None given out.

- **If any product using the invention has been sold or offered for sale, please specify to whom and on what date:**

Not offered for sale.

**6. DISPOSITION OF THE INVENTION:**

- **When will (or did) Micron begin use of the invention experimentally:**

lot G5-4244610. See SEM results: Wafers 10 and 8 had 10% Ag thin layer prior to Ag top electrode and the top electrode is smooth. Wafers 4 and 7 did not have this pre-layer of Ag and the top electrode is discontinuous.

- **When will (or did) Micron begin production of this invention:**

TBD.



**7. MISCELLANEOUS INFORMATION:**

- ARPA project:
  - Was the invention developed during a joint development agreement or other contract with an outside company:
- No.
- List developmental work outside of the company, including Government proposal or contract:

None.

**8. INVENTORS:**

•  
Name : Kristy A Campbell  
Home Address : 9845 W. Mossy Cup St.  
City : Boise State : ID Zipcode : 83709  
Citizenship : US  
Company : Micron Technology, Inc.  
Work Phone # : 363-1910 Mail Stop : 306  
Dept Name : R&D Dept # : 861  
Supervisor : Terry Gilton

Signature :

Date :

•  
Name : John T Moore  
Home Address : 12530 W. Lexus Ct  
City : Boise State : ID Zipcode : 83713  
Citizenship : USA  
Company : Micron Technology, Inc.  
Work Phone # : 368-5508 Mail Stop : 306  
Dept Name : PCRAM Integration Dept # : 861G  
Supervisor : Terry Gilton

Signature :

Date :

**9. WITNESS:**

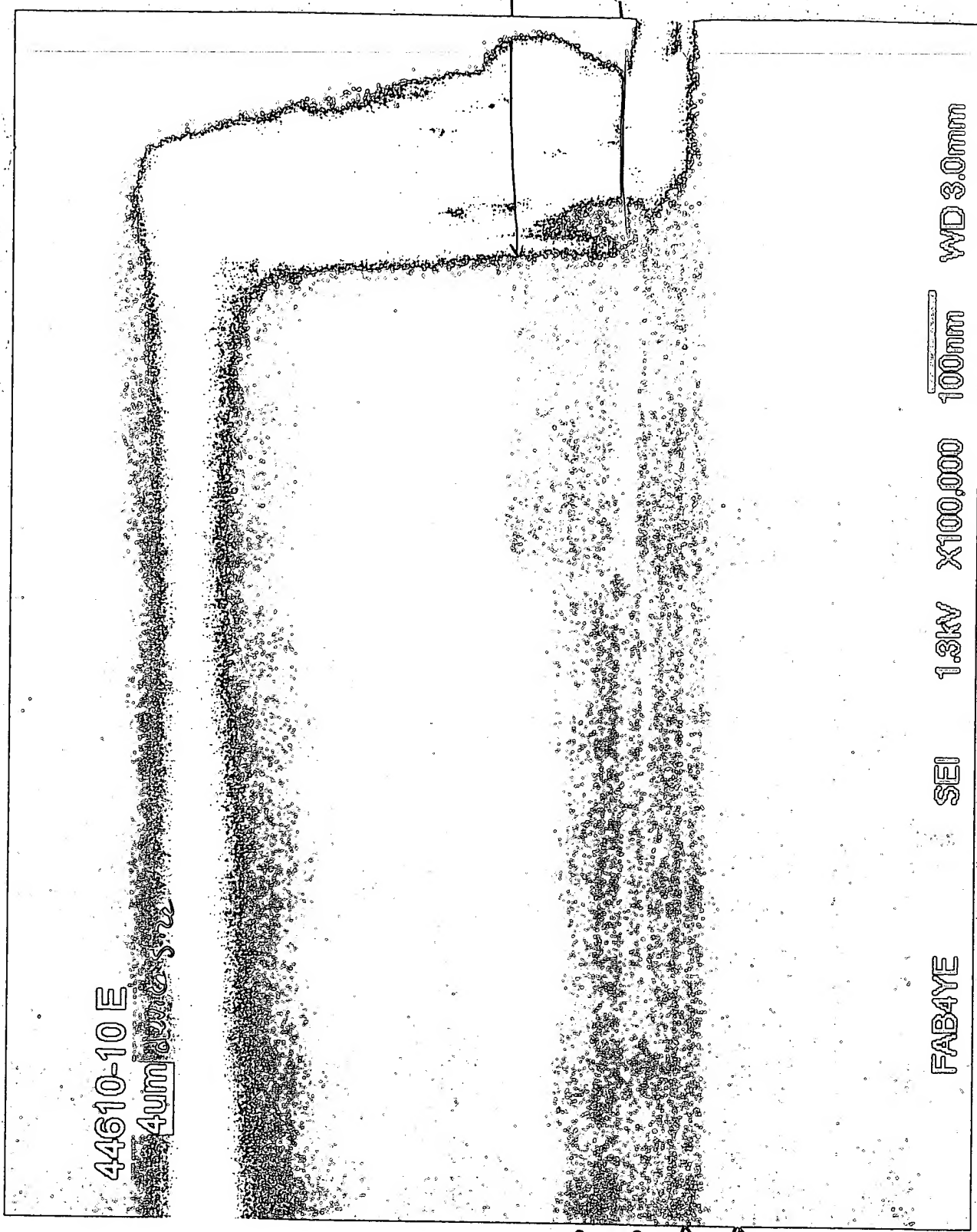
If there is only one (1) inventor, a witness should sign and date this disclosure. A witness in this case is a non-inventor who understands the nature of the invention.

\_\_\_\_\_  
( Signature of Witness )

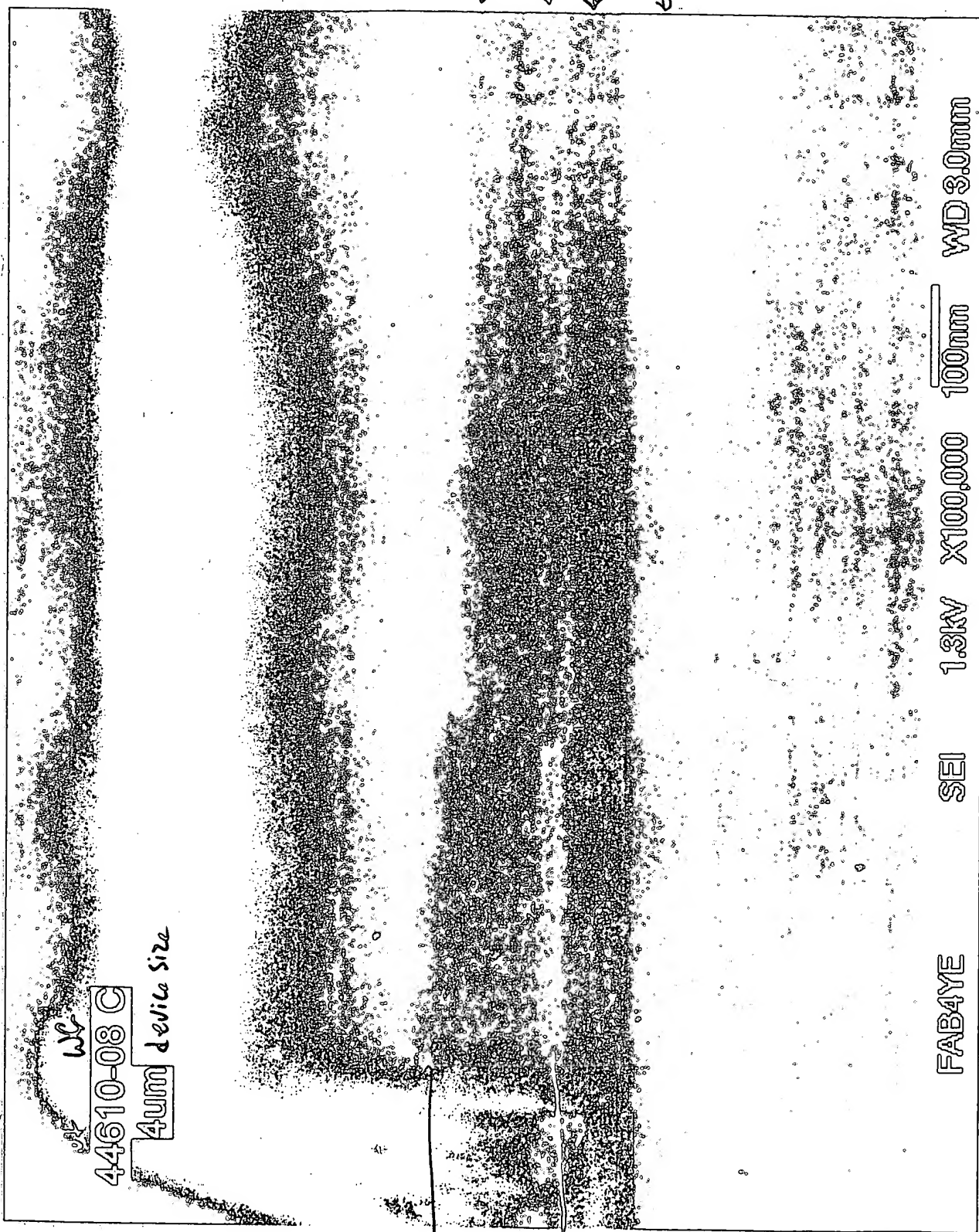
\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
( Date )

44610-10 E

4um 100nm 5.22



5 →  
4 →  
2 →  
1 →



WC

44610-08 C

4um device size

0

3

← 5  
← 4  
← 2  
← 1

FAB4YE

SEI

1.3KV

X100,000

100nm

WD 3.0mm

Description	.25um	.25um	.25um	.50um	1.0um	4.0um	8.0um	10.0um	
DC Init.	7.50E+08	1.48E+07	7.22E+03	8.96E+03	9.60E+03	5.11E+05	6.25E+06	1.40E+07	
DC Write	0.71	0.23	0.19	0.15	0.12	0.13	0.17	0.19	
Prog. Rs	7.57E+04	3.50E+04	1.03E+04	1.07E+04	1.42E+04	5.40E+03	5.83E+04	7.42E+03	
DC Erase	0.2	0.18	0.16	0.12	0.12	0.07	0.1	0.11	
Off Rs	1.35E+09	2.01E+10	4.70E+05	2.29E+08	8.30E+10	7.09E+09	2.10E+09	1.44E+07	

worked 1X	worked 3X
-----------	-----------

sweep -1V

worked

worked 3X worked 3X

Quasi DC

then WNE

many times

Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Prog Rs									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									
Erase Rs									

## Cycling

Cycling									
Resistor									
No# Cycles									
Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									

## Data retention

Time									
DC Write									
Prog. Rs									
DC Write									
Prog. Rs									

At Temp. 85°C

Description	.25um	.25um	.50um	.50um	1.0um	4.0um	8.0um	10.0um
DC Init.								
DC Write								
Prog. Rs								
DC Erase								
Off Rs								

Quasi DC

Prog. V (Vp)								
Prog. I (Ipc)								
Pulse Width (Ppw)								
Prog Rs								
Erase V (Ve)								
Erase I (Iec)								
Pulse Width (Epw)								
Erase Rs								

## Cycling

Resistor									
No# Cycles									
Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									

## Data retention

[illegible]



•

Time									
DC Write									
Prog. Rs									
DC Write									
Prog. Rs									

	Site		CENTER +4 LEFT			Vibrant purple pads			
Description	.25um	.25um	.50um	.50um	1.0um	4.0um	8.0um	10.0um	
DC Init.	6.05E+08	5.90E+05	8.72E+08	3.59E+08	1.17E+10	9.61E+09	2.20E+09	1.41E+09	
DC Write	W N W	0.2	0.39	0.22	0.24	0.27	0.19	0.26	
Prog. Rs	1.90E-01	2.30E+04	7.72E+03	2.62E+04	2.19E+04	5.99E+03	1.90E+04	4.20E+02	
DC Erase		0.2	W N E	0.11	0.1	0.21	0.9	WNE	
Off Rs		2.88E+06		2.69E+08	2.17E+06	3.13E+05	2.12E+07		

Quasi DC	2-3 writes	then WNW
----------	------------	----------

Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Prog Rs									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									
Erase Rs									

## Cycling

Resistor									
No# Cycles									
Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									

## Data retention

[illegible]

At Temp. 85°C

[illegible]

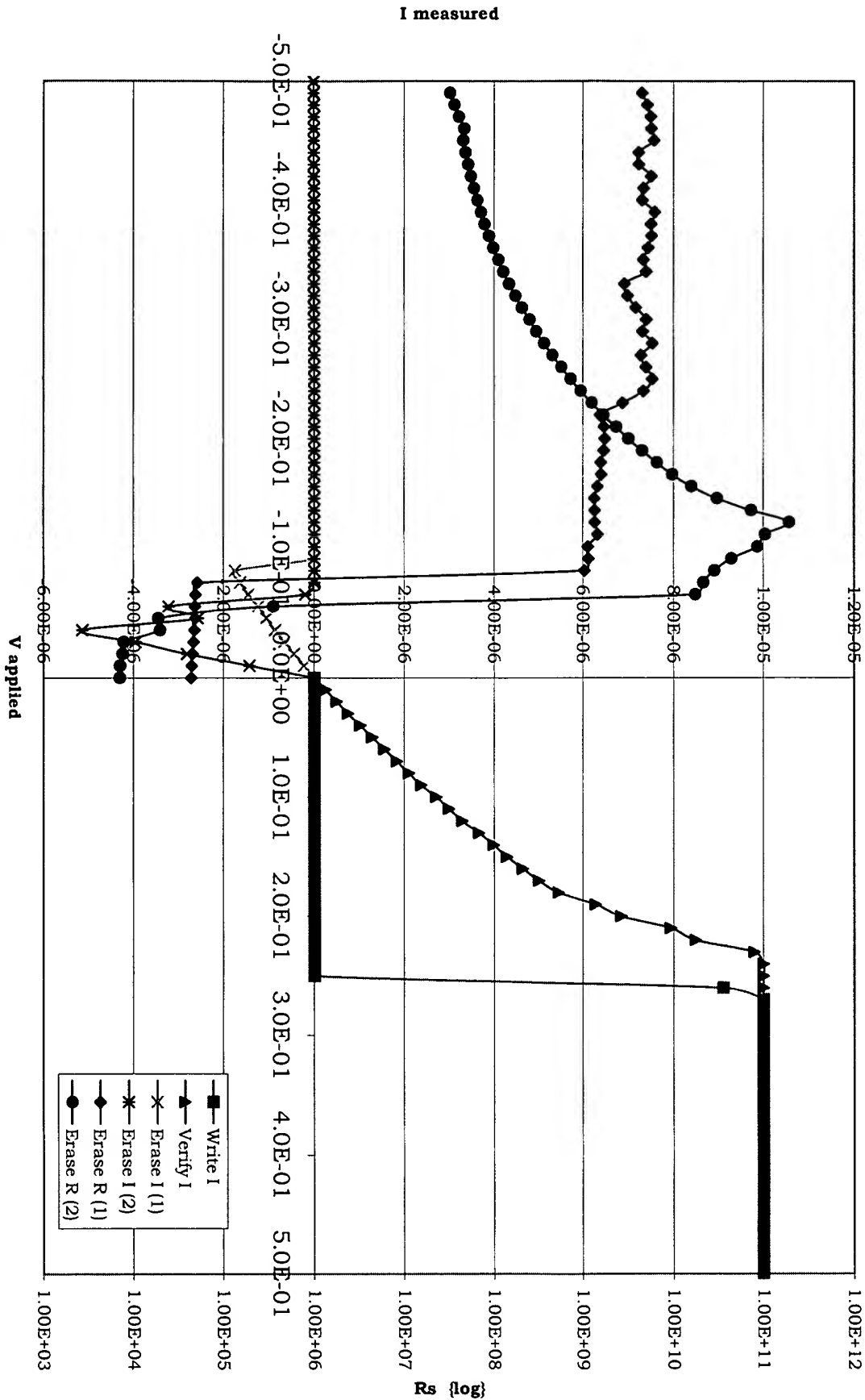
### Quasi DC

Prog. V (Vp)									
Prog. I (Ipc)									
Pulse Width (Ppw)									
Prog Rs									
Erase V (Ve)									
Erase I (Iec)									
Pulse Width (Epw)									
Erase Rs									

## Cycling

Resistor								
No# Cycles								
Prog. V (Vp)								
Prog. I (Ipc)								
Pulse Width (Ppw)								
Erase V (Ve)								







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